INTERNATIONAL JOURNAL OF DISCOURSE ON INNOVATION, INTEGRATION AND EDUCATION

Volume: 02 Issue: 02 | February 2021 ISSN: 2181-1067

http://summusjournals.uz/index.php/ijdiie

Use of Maple and Microsoft Excel Programs In Teaching Spheric Trigonometry

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ABSTRACT: *The use of modern information technologies in solving problems related to spherical trigonometry is invaluable for students majoring in geodesy, cartography and cadastre of technical universities. For this reason, the method of using modern information technology in teaching the science of spherical trigonometry is presented.*

KEYWORDS: *geometric figure, height, side, angle, side cosine, side sine, corner cosine, corner sine, Maple program, evalf, Microsoft Excel.*

INTRODUCTION

As a result of the growing needs of society in the field of geodesy and cartography related to space, including regions and natural celestial bodies, one of the ways to improve the quality of training, to develop students' logical, spatial imagination in the educational process.

Definition. The arc of a large circle drawn perpendicular to the opposite side from the end of a spherical triangle is called the height of the spherical triangle.

The heights drawn on the sides a,b,c of a spherical triangle are h_a, h_b, h_c marked accordingly in appearance.

The height of a spherical triangle can be shown to have the following properties according to its definition.

1-property. The height of a spherical triangle is equal to the product of the opposite side sine and the angle sine.

$$h_b = \sin c \cdot \sin A, \quad h_b = \sin a \cdot \sin C$$

The equations are reasonable.

2-property. The sine of the height of a spherical triangle is equal to the sine of the corresponding height of a spherical triangle.

$$\sinh_b = \sin c \cdot \sin A$$

It is known that the pole is for the sides and angles of a spherical triangle $c_1 = c - 180^0$, $A_1 = A - 180^0$ equations are reasonable. According to these equations, we obtain the following for the sine of the polar spherical triangle height.

$$\sinh_{b_1} = \sin c_1 \cdot \sin A_1 = \sin\left(c - 180^0\right) \cdot \sin\left(A - 180^0\right) = \sin c \cdot \sin A$$

that is $\sinh_{b_1} = \sin c \cdot \sin A$ equality is fulfilled. This is the side of equality $\sinh_b$ and $h_b = h_{b_1}$ therefore equality is appropriate.

3-property. The ratio of the sine of the heights of a spherical triangle is inversely proportional to the ratio of the sine of the sides of these heights.

According to property 1 for the heights of a truly spherical triangle

$$\sinh_a = \sin b \cdot \sin C, \quad \sinh_b = \sin c \cdot \sin A$$

By writing the equations and multiplying the first by e and the second by, we get the following equations:

$$\sin a \cdot \sinh_a = \sin a \cdot \sin b \cdot \sin C, \ \sin b \cdot \sinh_b = \sin b \cdot \sin c \cdot \sin A$$

To the right of these equations corresponds to the sine theorem for a spherical triangle

$$\frac{\sin a}{\sin A} = \frac{\sin c}{\sin C}$$

Or

$$\sinh_a \cdot \sin C = \sin c \cdot \sin A$$

Considering the equation, we see that the right sides of the equations are mutually equal. So we equate the left sides.

$$\sin a \cdot \sinh_a = \sin b \cdot \sinh_b$$

Both sides of the resulting equation $\sin a \cdot \sinh_b$ as an expression, we have an equation $\frac{\mathbf{sinh_a}}{\mathbf{sinh_b}} = \frac{\mathbf{sinb}}{\mathbf{sina}}$ that needs to be proved.

When solving problems using the Maple program, we provide the following information about the Maple program.

In the Maple system, passes the [evalf] command to the decimal fraction of a number and is used to calculate the value of trigonometric functions;

> - dialog icon. The flashing vertical line is called the input cursor;

The expression reminds you that the end of the (;) calculation must be displayed;

(:) - cancels a two-dot output, i.e. it is used to write multiple expressions on a single line or to separate them from each other.

Problem 1. (Calculate using Maple) Two sides of a spherical triangle $a = 78^0 40' 47''$ $b = 67^0 40' 23''$ lowered to the side of a $h_a = 59^0 15' 42''$ values are given $h_b = ?$ find the value.

Solution: Solutions created with Maple software.

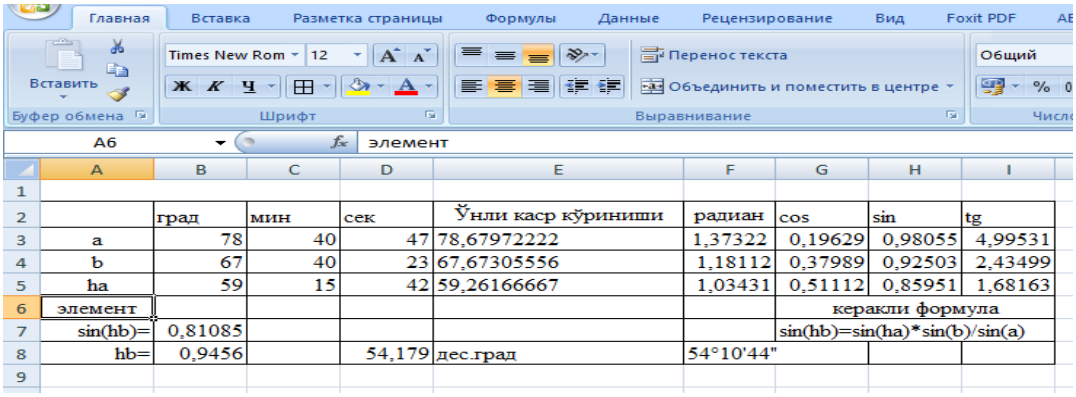
> a:=evalf(Pi/180*(78+40/180+47/3600)); $a := 1.365463189$

> b:=evalf(Pi/180*(67+40/180+23/3600)); $b := 1.173360616$

> ha:=evalf(Pi/180*(59+15/180+42/3600)); $ha := 1.031402322$

> hb:=arcsin(sin(hb)*sin(b)/sin(a)); $hb := .9409518160$

> evalf(convert(hb,degrees)); $53.91256777 degrees$



	A	B	C	D	E	F	G	H	I
1									
2		град	мин	сек	Ўнли каср кўриниши	радиан	cos	sin	tg
3	a	78	40	47	78,67972222	1,37322	0,19629	0,98055	4,99531
4	b	67	40	23	67,67305556	1,18112	0,37989	0,92503	2,43499
5	ha	59	15	42	59,26166667	1,03431	0,51112	0,85951	1,68163
6	элемент						керакли формула		
7	sin(hb)=	0,81085					sin(hb)=sin(ha)*sin(b)/sin(a)		
8	hb=	0,9456		54,179	дес.град	54°10'44"			
9									

1. [1] Kholmurodovich E. M. USING MAPLE MODULES IN SOLVING TASKS WITH BASIC FORMULAS OF SPHERICAL TRIANGLES //European Journal of Research and Reflection in Educational Sciences Vol. – 2019. – T. 7. – №. 11.

E3=B3+C3/60+D3/3600; E4=B4+C4/60+D4/3600; E5=B5+C5/60+D5/3600; H3=SIN(F3); H4=SIN(F4); H5=SIN(F5); B7=H5*H4/H3; B8=ASIN(B7); D8=ГРАДУСЫ(B8); F8=ЦЕЛОЕ(D8)&"°"&ЦЕЛОЕ((D8-ЦЕЛОЕ(D8))*60)&"'"&ОКРУГЛ (60*((D8-ЦЕЛОЕ(D8))*60-ЦЕЛОЕ((D8-ЦЕЛОЕ(D8))*60));0)&"""

100 students of the Karshi Engineering and Economics Institute majoring in geodesy, cartography and cadastre took part in the experimental work. We conducted experiments on the use of modern information technology in teaching the science of spherical trigonometry. In order to determine the reliability of the experimental work χ^2 the work was carried out on the basis of the criteria.

χ^2 – The results of the criterion were based on 4 types of assessment in the selected control and experimental group students- $C=4$. Then, assuming that p = 0.05, $K=C-1=3$ equal to, χ^2 is equal to e obtained on the basis of the $T_{кр}=7{,}81$ table.

$$T_{кузатув}=\frac{1}{n_1\cdot n_2}\sum_{i=1}^{4}\frac{\left(n_1Q_{2i}-n_2Q_{1i}\right)^2}{Q_{1i}+Q_{2i}} \qquad (1)$$

in order to determine the reliability of the experimental work χ^2 the work was carried out on the basis of the criteria.

H_0 hypothesis that there is no significant difference in the skills of students in control and experimental groups in teaching methods based on traditional teaching and the use of modern information technology on issues related to the topic of spherical triangles.

H_1 there is a significant difference in the skills of students in control and experimental groups in traditional teaching methods and methods of teaching using maple, Microsoft Excel programs on the topic of spherical triangle height as a hypothesis.

$H_0: T_{кр} \geq T_{кузатув}$ hypothesis (occurs) is found to be correct, alternative to it (alternative) $H_1: T_{кр} < T_{кузатув}$ the hypothesis (occurs) is found to be correct.

$$T=\frac{1}{50\cdot 50}\left(\frac{(50(13-3))^2}{16}+\frac{(50(17-15))^2}{32}+\frac{(50(18-28))^2}{46}+\frac{(50(2-4))^2}{6}\right)=$$

$$=6{,}25+0{,}125+2{,}173+0{,}66=9{,}2$$

henceforth, $H_1 : T_{кр.} = 7{,}81 < 9{,}2 = T_{кузатув}$ hypothesis (occurred) was accepted. In this case, too, the N0 hypothesis was rejected. An alternative is the H1 hypothesis, that is $T_{кузатув} > T_{кр}$, it was accepted and the reliability of the method of teaching the topic of Spherical Triangle Height using Maple, Microsoft Excel programs was tested.

Results of mastering by students of Karshi Engineering and Economics Institute of Geodesy, Cartography and Cadastre

Selections	86-100	71-85	55-70	55 and less	Number of students
Experimental group	$Q_{11} = 13$	$Q_{12} = 17$	$Q_{13} = 18$	$Q_{14} = 2$	$n_1 = 50$
Control group	$Q_{21} = 3$	$Q_{22} = 15$	$Q_{23} = 28$	$Q_{24} = 4$	$n_2 = 50$
	$Q_{11} + Q_{21} = 16$	$Q_{12} + Q_{22} = 32$	$Q_{13} + Q_{23} = 46$	$Q_{14} + Q_{24} = 6$	$n_1 + n_2 = 100$

The general result of the analysis of experimental work carried out at the selected Karshi Engineering and Economics Institute

	Experimental group NT = 50				Control group NH = 50			
Point value	**86-100**	**71-85**	**55-70**	55 and less	**86-100**	**71-85**	**55-70**	55 and less
Number of matching points	13	17	18	2	3	15	28	4
The arithmetic mean of the scores	X^*_T=3,82				X^*_H=3,34			
Efficiency coefficient	$\eta = X^*_T / X^*_H = 1{,}14$							

Thus, the study proved that the proposed teaching methodology was more effective than the traditional traditional teaching methodology (efficiency was 12 percent). The results of the experiments were analyzed by mathematical and statistical methods, and the scientific hypothesis proved to be correct.

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